

WHAT IS CLAIMED IS:

1. The process of fabricating an article comprising the steps of:

providing a substrate having a surface including one or more regions of catalyst metal for catalyzing the growth of elongated nanostructures;

- 5 growing on said one or more regions at least one elongated nanostructure having at least one substantially straight region and at least one curly defect region, the straight region grown under the influence of an electrical field and the curly defect region grown with the field off.

- 10 2. The process of claim 1 wherein:

the straight region is grown by chemical vapor deposition enhanced by plasma induced by a high frequency plasma source, and

the curly defect region is grown thermally while the plasma source is off.

- 15 3. The process of claim 2 wherein the defect region is grown by shutting off the plasma source for 1-60 seconds.

4. The process of claim 2 wherein the elongated nanostructure is a nanotube.

- 20 5. The process of claim 4 wherein the nanotube comprises in sequence a first substantially straight region, a defect region and a second substantially straight region.

6. The process of claim 4 wherein the nanotube comprises in sequence a first substantially straight region, a defect region, a second substantially straight region, a second defect region, and a third substantially straight region

5 7 The process of claim 4 wherein the nanotube exhibits electrically rectifying properties.

8 The process of claim 2, wherein the frequency is 915 MHz, 2.45 GHz, or 13.56 MHz.

10 9 The process of claim 4 wherein the plasma enhanced chemical vapor deposition is performed with a chemistry comprising ammonia.

15 10 The process of claim 4 wherein the plasma enhanced chemical vapor deposition is performed with a chemistry comprising ammonia and acetylene.

11. The process of claim 10, wherein the mass flow ratio of acetylene to ammonia is 10 to 50%.

20 12. The process of claim 4, wherein the substrate comprises a material selected from the group consisting of silicon, silica, Hf, AlN, Al₂O₃, Si₃N₄ and diamond, and the catalyst metal layer comprises an element selected from the group consisting of cobalt, nickel, iron, and alloys thereof.

25 13. The process of claim 12, wherein the catalyst metal layer is present in a thickness of 0.5 to 200 nm.

14. The process of claim 12, wherein the substrate comprises silicon or silicon oxide and the catalyst metal layer comprises cobalt or iron.

15. The process of claim 13, wherein the average nanotube diameter is 10 to 300 nm.

16. The process of claim 2, wherein the elongated nanostructures have an average length of 0.5 to 30 micrometers.

17. The process of claim 4, wherein at least a portion of the nanotubes comprise one or more encased catalyst metal particles.

18. The process of claim 17, wherein the encased catalyst metal particles are located proximate the substrate surface.

19. The process of claim 2, wherein the catalyst metal layer is a patterned layer, such that the nanostructures form in the pattern.

20. The process of claim 17, wherein the catalyst metal thickness controls the nanotube diameter.

21. The process of claim 4, wherein the high frequency plasma enhanced chemical vapor deposition process exhibits stages of growth, stability, and etch as to nanotube length.

22. The process of claim 2, wherein the plasma enhanced chemical vapor deposition induces formation of distinct islands of the catalyst metal, the nanostructure growth initiating on such islands.

23. The process of claim 2, wherein the growth rate of the nanostructures in height is at least 5 micrometers per minute.

24. The process of claim 23, wherein the growth rate per micrometer height is at least $0.01 \times 10^6 \text{ cm}^2$ per hour.

25. An article comprising an elongated nanostructure having in sequence a straight region and a curly defect region, the nanostructure acting as an electrical rectifier.

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26. An article comprising an elongated nanostructure having in sequence a straight region, a curly defect region and a straight region, the nanostructure acting as an electrical rectifier.

27. An article comprising an elongated nanostructure having in sequence a straight region, a curly defect region, a second straight region, a second curly defect region and a third straight region, the nanostructure acting as an electrical rectifier.